High-Performance Mobile PCs:

Transforming the Workplace

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Executive Summary

In the office or on the road, the mobile PC is an important business tool for a large segment of today's corporate workforce – with good reason. Notebook users are more productive because they can make decisions, handle urgent messages, and create or access information anywhere, anytime. Clearly, there are compelling reasons for companies to invest in mobility. But beyond the simple decision to buy a notebook PC, there is another, more complicated question: How much does performance matter? High-end mobile systems with more powerful processors are more expensive, so is the extra performance worth the incremental cost?

Of course there are engineers, developers, architects, graphic designers and others whose specialties require the highest levels of performance. But what about everybody else? Does a day-extender who uses e-mail, writes memos, and occasionally builds a presentation or a spreadsheet really need a notebook PC with a core processor speed that is measured in gigahertz?

The answer is an unequivocal yes. Both speed and mobility matter. To achieve the highest productivity and realize the greatest return on investment, it makes sense to buy a notebook with a level of performance that can handle the biggest challenges today, while providing the performance headroom for the needs of tomorrow's CPU-intensive applications.

Several information-technology trends are emerging that enhance business-user productivity. Enterprise computing is gravitating toward mobile PCs with high-performance processors in order to accommodate increasingly processor-intensive applications and operating systems. New classes of software are tapping vast databases and employing sophisticated analysis and visualization techniques. New operating systems, utilities and Web services are running virus protection, encryption mechanisms and other types of background processing. Wireless technologies are expanding the scope of mobile computing by making plugging in to a phone jack an option rather than a necessity.

All of these emerging trends and technologies are increasing the workload on mobile processors, and should be considered in any notebook purchasing decision.

This white paper presents an overview of mobile computing within the context of five emerging technologies: Visual Computing, XML-Enabled Applications, Knowledge Management, Wireless Technologies and Windows* XP Optimization. Individually and collectively, these trends present a strong case for purchasing notebook systems that feature high-performance mobile processors.

Introduction

Making a case for purchasing mobile computers is easy – any business professional can work faster, leaner, and smarter when freed from the constraints of the desktop. Notebook users have greater control over when and where they work, which increases job satisfaction, employee retention rates and – most importantly – productivity. According to research by Gartner Consulting*, business users with a notebook computer who spent 20% or more of their time out of the office realized a minimum annual dollar benefit of $34,560 in productivity gains and efficiency savings.[1]

Such productivity gains have prompted many forward-thinking companies to equip the majority of their employees – not just salespeople – with mobile PCs. PeopleSoft, Inc., to give just one example, now provides notebooks to every one of its 6000 employees at 39 sites in the U.S. and around the world.[2]

It's become very easy to justify choosing a mobile PC for mainstream business users. But the purchase of high-performance mobile PCs requires a more involved thought process. After all, high-performance mobile PCs cost more. Is the additional speed worth it?

High-performance mobile computing has never been more important than it is today because of the vast array of new applications, utilities and operating systems that require serious processor performance. 3D graphics,

video and audio are embedded in everything from PowerPoint* presentations to Web sites.

Moreover, many of the complex security tasks that mobile PCs are now required to perform, such as virus scanning and encryption, are running invisibly as the user works with foreground applications. New compression utilities automatically compress and decompress e-mail file attachments to reduce data traffic and free storage space. And many IT departments are deploying asset-management and software-distribution background applications that bring uniformity and order to system configurations across the enterprise, while users make their own individual demands on their PC processors.

Even Microsoft Office* productivity suites are presenting new challenges that require heavy lifting from PC processors, mobile and otherwise. Microsoft Office XP employs XML to create rich, programmatic linkages between documents and data, letting users grab tables, charts, and other information from their favorite online sources and integrate them into Office XP documents and presentations. Processor performance is the key factor in this linkage, enabling mobile PC users to take full advantage of these new capabilities.

The wave of the future in applications and operating systems is clearly in the direction of multitasking, background processing and high-volume data retrieval. With more than a decade of processor design and manufacturing for the mobile market, Intel has the track record and expertise to provide the high-performance mobile processors that business professionals need. In particular, the Mobile Intel® Pentium® 4 Processor – M offers a unique combination of high performance and low power consumption for capitalizing on compute-intensive applications and mobile-usage models. Let's take a closer look at how high-performance mobile processors from Intel make the most of current and emerging technologies for all types of business users.

Visual Computing: Multimedia Enters the Mainstream

Pie charts. Bar graphs. Clip art. They're the staples of corporate presentations. But rapid adoption of visual technologies is creating new possibilities for eye-catching, attention-getting presentations. For instance, digital cameras and photo-manipulation software are making it easy to add photography to presentations. Digital camcorders and multimedia applications such as Macromedia Flash* are enabling video action, animation and sound.

Aside from enhancing presentations, sophisticated visual technologies are making it possible to apply 3D modeling, photo-realistic imaging, animation and streaming video to a variety of business challenges. For example, business analysis and visualization (BAV) applications generate 3D charts and graphs that allow users to visualize data in new ways, draw conclusions faster and achieve greater insights.

Moreover, visually based e-Learning helps companies quickly train employees on new technologies, products and services. Users can view training modules on their PCs when they need a just-in-time learning experience, or interact with a 3-D model to do a virtual run-through of a complex process before tackling the real procedure. Training time and costs can be substantially reduced.

Perhaps the Visual Computing applications with the greatest potential for transforming business in the near term are in the areas of collaboration and customer orientation. For example:

- Product engineers and suppliers can participate in online product discussions and design reviews while manipulating a product schematic or 3D model on screen in real time (see Figure 1).
- Marketing teams can visualize a new product early in the design cycle to ensure that marketing requirements are being met.
- Facilities-design engineers can "walk through" a future production line with customers to show them the location of design components, providing a better opportunity to spot potential problems (and avoid rework) than looking at a 2D blueprint.
- A company with complex packaging needs can show its supply chain partner thousands of miles away how a box should be folded or a package assembled.

- Accountants can show the tax consequences of a business decision in graphic detail.
- IT managers and consultants can show rather than just speak about the traffic load on various network sectors.

High-performance mobile PCs enable businesses large and small to take full advantage of sophisticated, high-end visualization applications that enhance organizational effectiveness – proving that a picture is indeed worth a thousand words.

Benefits of Visual Computing for Business

- More dynamic presentations: Video clips, photos and animation can now be incorporated for greater impact. Mobile Intel® Pentium® 4 Processor – M-based notebooks can deliver presentations with a new level of audio-visual appeal.
- Enhanced training and business analysis applications. The benefits of Visual Computing extend to business analysis and visualization software as well as sophisticated 3D training programs.
- Improved collaboration and customer orientation: Next-generation visual collaboration tools allow geographically dispersed employees and their partner companies to work together to speed decision making, increase innovation and cut costs. High-performance mobile PCs can make 3D models widely available throughout the company and the supply chain.

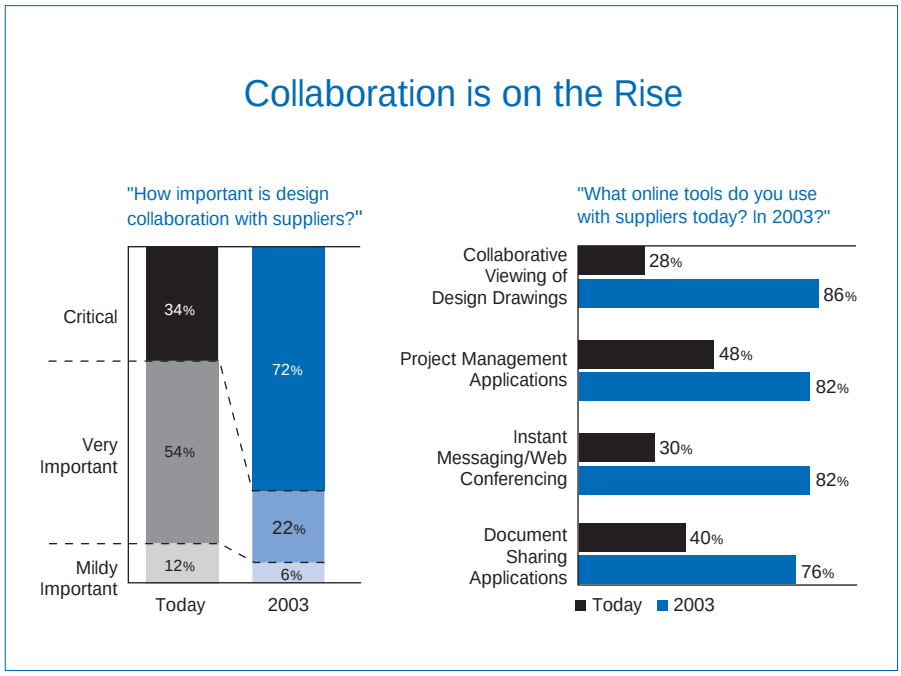

Figure 1. Collaboration is on the rise. 86 percent of manufacturers surveyed said they expect to implement collaborative viewing of design drawings by 2003. Source: Forrester Research, Inc, June 2001

XML: The Hot New Standard for Application Interoperability

XML acts like dynamite when it comes to tearing down barriers to data exchange. Short for eXtensible Markup Language, XML is a relatively new specification created by the World Wide Web Consortium (W3C) that provides a common format for documents, so that both the format and data can be shared freely on the Web, intranets, extranets and elsewhere.

Using XML, companies can exchange information easily and affordably between disparate departments, businesses, applications and platforms. Processes such as order entry, material resource planning, pricing and inventory control can be automated. XML makes it possible to develop an integrated process that maintains a single store of content to be delivered throughout multiple organizations to many types of access devices, including mobile PCs.

XML support is being built into software of all kinds, including Microsoft Office* XP, Windows* XP and Internet browsers, as well as new and legacy applications such as enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM) software. But while XML boosts user and company productivity, it also adds to the computing workload – requiring PCs with high-performance processors.

Industry analysts are predicting a tidal wave of new data on desktop and mobile PCs beginning in 2002 as a result of XML adoption. According to Zona Research*, the XML adoption rate will be faster than those of the Internet, World Wide Web, e-Commerce, or even cell phones (see Figure 2).[3] By deploying high-performance notebook PCs, companies are well positioned to turn critical new technologies like XML into a competitive advantage for themselves and their business partners.

For mobile computer users, XML provides a new degree of freedom because of the interoperability it brings to server and client applications. Business people can use their notebooks offline, secure in the knowledge that whenever and wherever they sync up with network applications, the process will be seamless. And when connections are made wirelessly, this synchronization becomes even more seamless and convenient to the mobile user.

In a fully XML-enabled world, there are no penalties for working out of the office. With Mobile Intel® Pentium® 4 Processor – M-based notebooks, mobile users can confidently conduct Business-to-Business interactions anywhere, and take collaboration to new levels of efficiency and productivity.

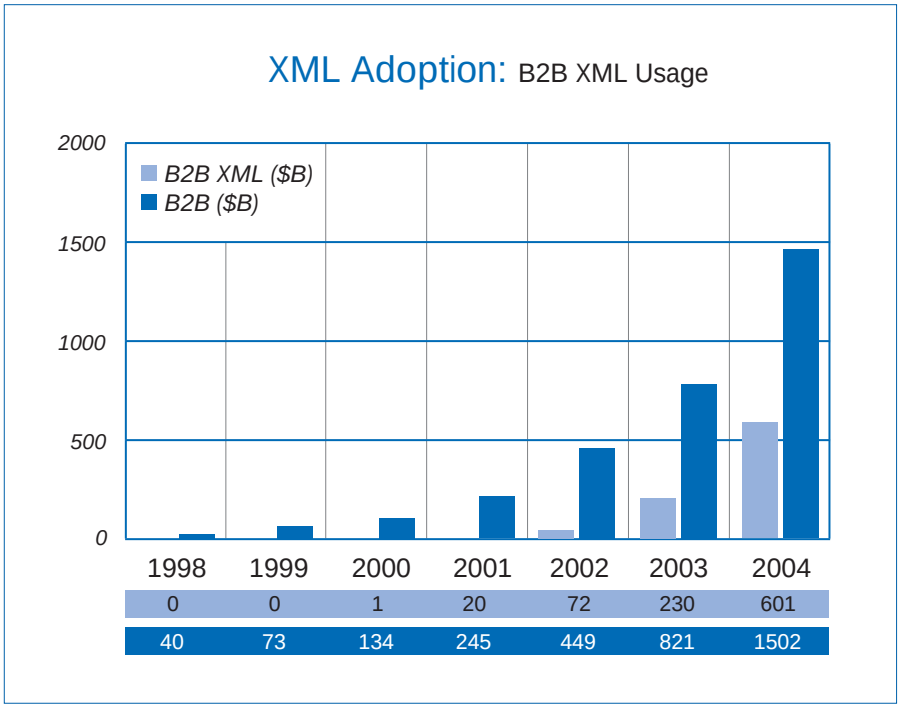

Figure 2. XML-based B2B transactions. Adoption rates for XML technology are expected to outstrip the Internet, Web, e-Commerce and even cell phones. Source: Zona Research, March 2000

Benefits of XML for Business

- Rapid, automatic data exchange. XML-based documents can be transferred freely between applications, documents, departments and companies.
- Content access to legacy data. Users can extract data from back-end and legacy systems and share it with other employees, customers and business partners.
- Easy application synchronization. XML enables mobile PC users to run server-based applications even when disconnected from the network, providing an infrastructure for easy synchronization between the local application client and the server.
- Secure data transfer. XML data can be safely transported outside the firewall and over the Internet, enabling ubiquitous access by authorized users inside and outside the office.

Knowledge Management: Getting a Handle on Information Assets

Too much information. Too many sources. Too little time to digest it all. Information overload has given rise to serious losses in productivity, as workers spend more and more time every year searching for vital information that is lost within corporate information systems (see Figure 3).

Knowledge Management (KM) solves the problem by aggregating multiple sources of information, applying personalized logic to extract maximum value from that information, and offering advanced interfaces to help users share their learning.

Today's Knowledge Management applications are providing capabilities such as automatic information retrieval, personal content categorization, learning and adaptation, and collaboration. Next-generation KM software is likely to provide even more comprehensive solutions. This will enable companies to access information in real time pertaining to sales, Web site usage patterns, competitors' initiatives, newsgroups and much more.

Deploying Mobile Intel® Pentium® 4 Processor – M-based notebooks enables businesses to make the most of today's knowledge management tools, as well as those that are still emerging. KM tools can transform mobile PCs from personal productivity and communication tools into platforms of Internet productivity, knowledge assimilation, and overall business success. By choosing mobile PCs with the highest performance available, companies avoid compromising system responsiveness as new, processor-intensive KM applications are deployed.

Benefits of Knowledge Management for Business

- Time savings. Decreases time-to-output by enabling employees to make faster, better-informed decisions at all levels of the organizational hierarchy, even when they are out of the office.
- Better information dissemination. Minimizes the time spent on "reinventing the wheel" by capturing best practices and making this knowledge available throughout the enterprise.

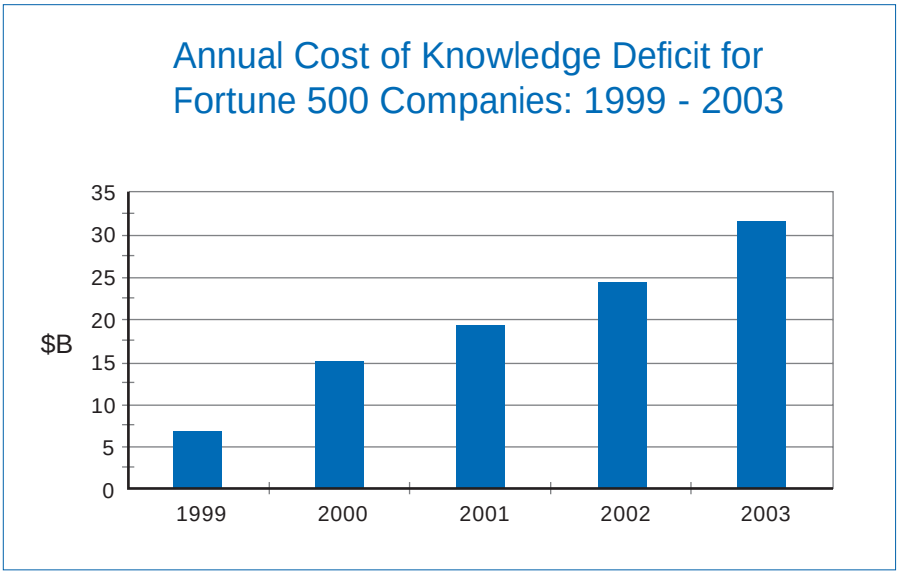

Figure 3. Information overload consequences. When knowledge workers don't have the needed information in time, the result can be substandard performance, wrong decisions and repeated "reinventing the wheel." Source: "Knowledge Management Factbook," International Data Corporation, September 1999

- Enhanced use of information. Fosters innovation and raises customer satisfaction by enabling organizations to exploit the full value of their information assets.

Wireless Technologies: Maximizing Mobility and Productivity

Business demand for wireless connectivity is growing dramatically worldwide. Being able to remain constantly connected, without continually plugging and unplugging, makes wireless mobile computing more efficient and productive than the wired alternative. This holds true whether the user is traveling to a conference across the continent, or a conference room across the hall.

A 2001 Sage Research* report based on interviews with twenty large North American companies found that employees realized an additional eight hours per week of productivity when using mobile PCs and a corporate wireless LAN (WLAN).[4] Similarly, Gartner Consulting reports that professional wireless users with notebooks who spend 20% or more the time out of the office experience 41% higher productivity gains and efficiency savings compared to wired professionals with notebooks. Gartner estimates the time value of this gain at 7.5 additional hours of per week.[5]

Wireless devotees can take advantage of this technology in numerous ways, including:

- Accessing data on enterprise systems wherever they need it
- Collaborating with colleagues in real time during meetings
- Conducting online demos at client sites

- Responding promptly to urgent messages from anywhere in the world
- Improving customer relations and support by spending more time interacting with clients at varied locations
- Communicating and collaborating globally, across time zones, for 24/7 productivity

These usage models may sound familiar, as they are similar to the benefits already cited for high-performance mobile computing. However, wireless connectivity elevates these benefits to a higher plane by putting an end to any and all location dependencies.

Today, wireless solutions are growing in popularity due to higher speeds, greater interoperability and lower prices. More options are becoming available, too. Mobile PC users in corporate environments and public places have several different choices for wireless connectivity, including the 802.11x WLAN standards and Bluetooth* wireless technology.

Bluetooth wireless technology allows you to create "personal connections" around your mobile computer, consisting of mobile phones, personal data assistants, and other portable devices – all without device cables and adapters. The 802.11x wireless standard enables mobile users to connect to wired network backbones.

*Bluetooth is a trademark owned by its proprietor and used by Intel Corporation under license.

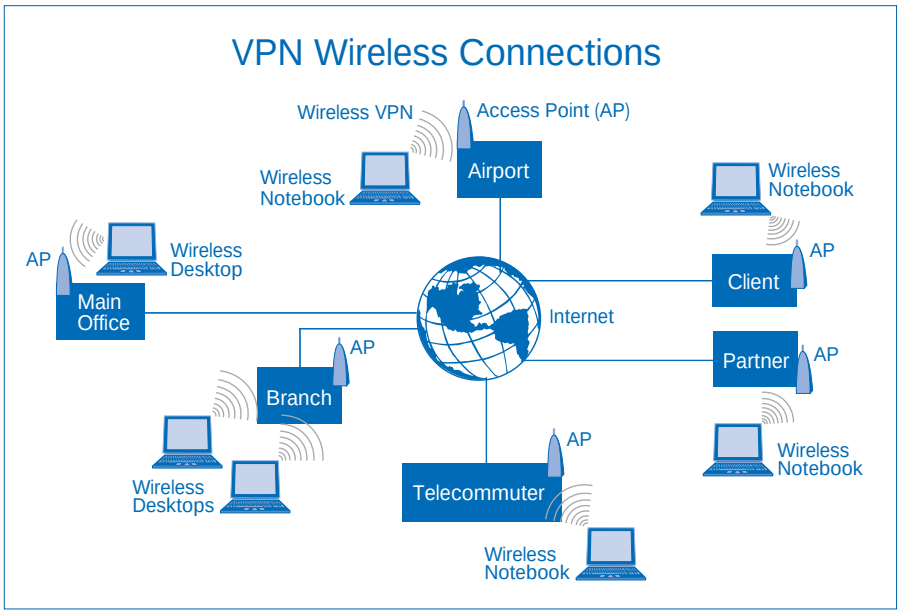

Figure 4. VPN wireless connections. Using wireless VPNs, data is encrypted and can be shared with partners, clients and colleagues between any location. Intel Mobile Solutions Group, 2002

Something to consider when using wireless technologies is their inherent vulnerability. Therefore corporate IT departments are insisting upon the use of authentication and encryption technologies by notebook users – whether using the corporate WLAN or working in a remote location.

One way to help ensure that wireless communications are secure is to deploy Virtual Private Networks, or VPNs. VPNs can apply authentication and encryption mechanisms at the client computer, the router or gateway (see Figure 4).

Encryption algorithms demand a lot of processing power, and if performance slows down noticeably, users may be tempted to store or transmit data in clear formats. Mobile Intel® Pentium® 4 Processor – M-based notebooks offer the processing power needed to run sophisticated applications while encrypting and decrypting data on the fly – with no significant effect on system performance. And Intel is always pushing the performance envelope to meet the demands of tomorrow's evermore sophisticated applications and security algorithms.

The next generation of wireless connectivity products, collectively known as 3G technologies, will offer improved frequency efficiency, and will enable faster data transfer rates for vastly improved performance on multimedia and other bandwidth-intensive applications. However, a high-performance notebook processor will be required to drive these improvements.

Benefits of Wireless Technologies for Business

- Higher productivity. Mobile users who spend 20% or more time out of the office report a 41% increase in productivity.
- Anytime/anywhere access to critical data. In an airport, conference room, or client's office, wireless technologies enable access to critical data via the Internet or across business networks. Mobile PC users can transfer documents and access e-mail instantly.
- Compatibility with security solutions. VPNs, encryption and other security solutions can be deployed effectively with wireless technologies when high-performance mobile processors are used.

Windows* XP: Enhancing the Mobile User Experience

The Mobile Intel® Pentium® 4 Processor – M delivers exceptionally high performance and low power utilization. Microsoft Windows* XP Professional enhances the low-power capabilities of the Mobile Intel Pentium 4 Processor – M with better power management than previous Windows* operating systems. In addition, it offers easier networking access, automatic wireless networking configuration, improved offline productivity and support for 802.11x security standards.

With Windows XP running on a Mobile Intel Pentium 4 Processor – M-based notebook, users can roam across wireless LAN networks without having to reconfigure network connection settings. Their files can be encrypted using a randomly generated key that offers the highest level of protection from hackers and data theft. And they gain improved power management for working longer on battery power.

Windows XP also enhances the multitasking and digital media capabilities of the Mobile Intel Pentium 4 Processor – M. By running Windows XP, notebook users can easily handle digital video, audio, photography, communications, and 3D graphics today and tomorrow. They can also take advantage of new technologies that are just beginning to emerge in the corporate environment. For example, instant messaging has been expanded through the Windows* Messenger* feature of Windows XP to include voice and video. Adding a high-speed connection to the mix lets high-performance notebook users see and hear clients and colleagues all over the world, rather than just viewing text messages.

Benefits of Windows* XP Optimization for Business

- Lower power consumption. Windows XP increases the power savings of the Mobile Intel Pentium 4 Processor – M with better battery management and more efficient handling of configuration, encryption and other tasks. Windows XP also offers complementary features, such as "Standby" and "Hibernate" modes, that further extend the time users can work between battery charges.
- Ability to create rich digital media. Technologies such as streaming audio and video, digital photography, and 3D graphics all require sophisticated processor and operating system capabilities. Windows XP is optimized for the Mobile Intel Pentium 4 Processor – M, which features high-performance Intel® NetBurst™ microarchitecture and outstanding throughput.
- Muscle for multitasking. Most people typically run several applications at the same time, and background tasks such as networking and encryption impose their own processor load. Windows XP and the high-performance Mobile Intel Pentium 4 Processor – M provide the necessary resource sharing and load balancing for such activities.
- Support for emerging technologies. Digital imaging, communications and 3D graphics are all enhanced by the Mobile Intel Pentium 4 Processor – M and Windows XP optimization. High-performance mobile Intel® processors and Windows XP also support emerging technologies such as voice- and video-enabled Windows Messenger.

The Evolving Mobile Intel® Processor

Intel is known for delivering innovative technologies and driving standards that make mobile computing a more liberating, cost-effective and productive experience. Today, Intel offers a range of mobile processors that provide high performance and low power in each notebook PC segment. Take the Mobile Intel® Pentium® 4 Processor – M and Mobile Intel® 845MP chipset for example.

The Mobile Intel Pentium 4 Processor – M is manufactured using the latest 0.13-micron process technology, which enables greater speeds while lowering power consumption. With processor speeds up to 1.70 GHz and higher, a 400 MHz system bus, and 512 KB on-die L2 cache memory, it's the fastest mobile processor available. Performance-enhancing technologies like Rapid Execution Engine, Execution Trace Cache and Hyper-Pipelined Technology improve execution throughput, instruction storing, fetching, and decoding for even better performance. Plus, new Streaming SIMD Extensions 2 give software developers additional capabilities for accelerating video, multimedia, 3D, imaging and encryption.

The Mobile Intel 845MP chipset moves data rapidly between memory, I/O devices, graphics and other bus devices. Support for up to 1 GB of DDR memory accelerates applications, while flexible, external AGP4X graphics support enables the highest graphics performance and greater power management.

Intel consistently pushes the envelope with every new product launch. New levels of processor performance, low-power innovations and cooling technology breakthroughs that are built into the Mobile Intel Pentium 4 Processor – M continue to set new standards in mobile processing.

Intel® Brand Value

Visual Computing, XML, Knowledge Management, Wireless and Windows* XP are just five of many emerging technologies that rely on the availability of high-performance mobile processors. But performance is only part of the equation. As Justin Rattner, director of Microprocessor Research Labs and an Intel Fellow said, "It's no longer just about gigahertz, or the price of the box. It's about the total user experience, and making that experience more satisfying."

Intel has the knowledge, experience and the resources to make the total mobile computing experience as satisfying as it can be. Specifically regarding mobile PC technologies, Intel's commitment and record of innovation spans the entire history of mobile computing. Intel is a leading developer and promoter of industry standards in areas such as USB, PCI, ACPI, 802.11x and Bluetooth* wireless technology, as well as low-power and cooling technologies.

Intel's extensive involvement with third-party vendors – from PC manufacturers to software developers – enables business customers to choose from a wide array of innovative, cost-effective solutions, all optimized for Intel® architecture. And, of course, Intel ensures constant improvements in performance, as well as the highest levels of stability, reliability and manageability due to an ongoing commitment to research and development.

When it comes to quality assurance, Intel maintains the industry's most comprehensive validation program for processors and platforms. In 2000 alone, Intel spent more than $200 million on validation testing, and had over 900 employees involved in compatibility and reliability programs. Extensive CPU and systems tests ensure compatibility and optimized performance with a wide range of operating systems, network devices, third-party hardware components and software applications.

Mobile platforms receive additional tests to ensure that all hardware, software, OS and business applications work smoothly with specialized mobile features, such as the power management capabilities of Enhanced Intel® SpeedStep™ Technology. Tests are also performed under a wider array of operating conditions than for desktop systems. Altogether, mobile reference platforms undergo approximately 26,000 hours of additional testing and validation activities.

Conclusion

Current and emerging technologies require high-performance mobile processors with the headroom to accommodate more and more processor-intensive tasks. Intel continues to create mobile solutions that meet and exceed the performance expectations of our business customers. But performance must be balanced with other attributes that assure rapid return on investment and long-term satisfaction. By standardizing on high-performance mobile Intel® processor-based PCs such as the Mobile Intel® Pentium® 4 Processor – M, companies gain not just speed, but all the mobile processor innovations Intel has to offer.

[1] "Benefits and TCO of Notebook Computing," Gartner Consulting, July 19, 2001. These interview-based results may differ from Gartner's published research positions.

[2] Intel, "PeopleSoft: Company on the Move." Available at http://www.intel.com/eBusiness/casestudies/snapshots/peoplesoft.htm

[3] Zona Research, Inc., XML: The Air You Will Breathe, March, 2000.

[4] "Wireless LANs: Improving Productivity and Quality of Life." Published by Sage Research 2001. Available at http://www.intel.com/ebusiness/products/related_mobile/wp012603_sum.htm

[4] "Benefits and TCO of Notebook Computing," Gartner Consulting, July 19, 2001. These interview-based results may differ from Gartner's published research positions.

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